

## Lessons learned from the use of a Real-time Monitoring System for Thai Traditional Medicines and the path to Universal Health Coverage

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## 1. Introduction

Traditional knowledge of health care in Thailand, referred to as Thai Traditional Medicine (TTM) or Kan Paet Pan Thai, has a rich history of application in disease prevention and treatment. However, TTM's prominence waned for about six decades since the 1920s when Western medicine took precedence (1). The revival of TTM began in the 1980s, supported by government policies that encouraged the use of medicinal plants in primary health care and facilitated systematic research on herbal remedies (2). Thai traditional and alternative medicines (TT&AM) have been integrated into Thailand's Universal Health Coverage (UHC) Scheme since its establishment in 2002. Its service coverage has progressively expanded ever since. In 2015, it was officially included in the Ministry of Public Health (MOPH)'s service plan, solidifying the position of TTM services within the overall healthcare system as part of UHC's health service. Reimbursable treatments and rehabilitation under the Thai UHC scheme include Nuad Thai (traditional Thai massage), hot herbal compression, herbal steam bath, hot salt pot compression and other post-partum care, herbal medications in the National List of Essential Herbal Medicines, and acupuncture. Since TT&AM services have officially been a part of the MOPH service plan, the number of treatment and rehabilitative therapies has grown rapidly. The integration of TTM and traditional Chinese medicine in Thailand's healthcare system met the WHO's criteria as an "integrative system." (3, 4)

The Department of Thai Traditional and Alternative Medicine (DTAM) is the national authority under MOPH that manages and ensures the accessibility and quality standard of TT&AM services in all levels of public health service facilities across the 77 provinces of Thailand. In 2013, DTAM, in collaboration with the Provincial Health Office (PHO) of Sakaeo province, the National Health Security Office (NHSO), and the Information and Communication Technologies Center of MOPH, therefore introduced a TT&AM service reporting online dashboard with the idea of 'Everywhere and Every time.' This program, called 'Health Data Center for TTM Service or HDC TTM Service,' integrates the existing MOPH-HDC information management system and the electronic reporting system for monitoring and evaluating TTM services. The HDC-TTM Service retrieves information on TT&AM service from the MOPH HDC database. It receives service record data from health service facilities nationwide and presents it on a dashboard within 24 hours (Figure 1). Collecting services record data for HDC TTM Service involves three steps. Firstly, health service facilities report primary data on the provided services to the provincial HDC. These data undergo quality inspection before being uploaded to the MOPH's 'HDC-on-cloud.' Lastly, the information is summarized as a 'Summary table' or 'S\_table' and transferred to DTAM's virtual server for display on the HDC TTM Service dashboard. The entire operating process takes approximately 24 hours(4).

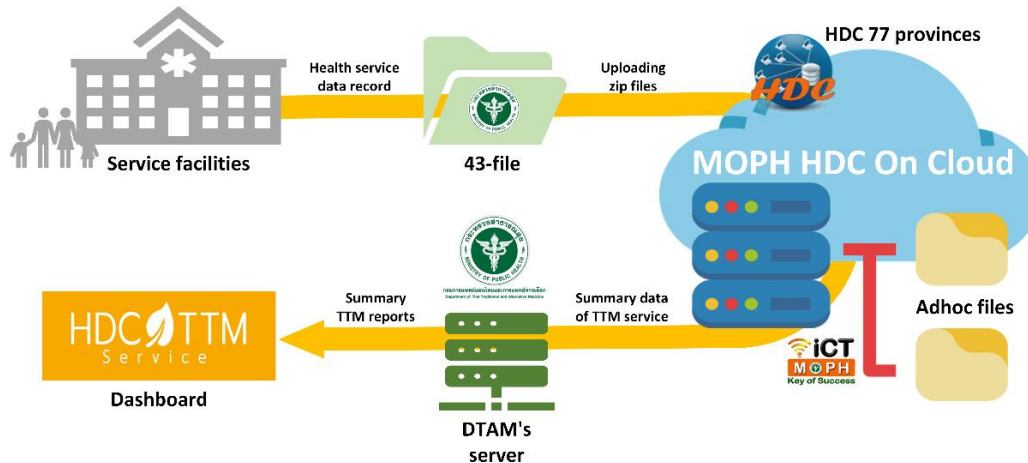


Figure 1 Flow of TTM service information from health service facilities to HDC TTM Service dashboard.

This process served as a ‘real-time monitoring system’ (RTMS) to report and manage the information system of TT&AM services in all health service facilities across the country in real-time. RTMS is being used to track TT&AM services across 13 health regions, UHC budget allocation and planning by the Thai MOPH, in conjunction with the public health security schemes, and there is potential for using it more strategically in the coming years(4, 5).

The implementation of RTMS over the past years offers a valuable case study for other countries in the region to develop a TTM service information system and utilize it to promote access to UHC. As set out by the WHO Traditional Medicine Strategy 2014-2023(6), integrating TTM services into the national health system has been one of the strategies to promote the use of traditional and complementary medicines for health. In this regard, the WHO South-East Asia Regional Office (WHO SEARO), in collaboration with DTAM and the Health Intervention and Technology Assessment Program (HITAP), Ministry of Public Health, Thailand, seeks to review the implementation of RTMS of TTM in Thailand and offer lessons for other countries in the Southeast Asian region.

This study aimed to assess the implementation process of the RTMS system for TTM services within the healthcare system of Thailand, identify factors that facilitated or hindered its development and adoption and extract valuable insights and recommendations for future development. Lessons learned from this study can be applied to similar settings in enhancing the understanding and effectiveness of service monitoring systems for traditional medicines.

## Methods

This study was carried out in five stages. Firstly, the desk-based review was conducted to understand the current landscape of RTMS, and frameworks used to evaluate similar health information systems. Secondly, the identified frameworks were used to create a conceptual framework to inform the study design. This study framework was later presented to the stakeholder for inputs and adjustment of study methodology. In the third step, we conducted key informant interviews (KIIs), specifically with policymakers, healthcare professionals, and staff involved in TTM services and using the HDC TTM Service system. The data obtained from these interviews were analysed using a thematic analysis approach. The thematic analysis allows data organization to be categorized into main themes and sub-themes, providing a comprehensive understanding of the issues and perspectives related to our research objective. Finally, the study results were presented to stakeholders during a consultation meeting in the fifth step to formulate key lessons learned, conclusions, and recommendations from the study. More details on each step are described below.

### Step 1: Desk-based review for the RTMS

To evaluate the development and implementation of RTMS in the HDC-TTM service, the research team conducted a desk-based review of existing frameworks on the health information monitoring systems in Thailand and other settings. As the evaluation and study of RTMS for traditional medicine are very new, the information on the current RTMS of TTM services is limited. Databases such as PubMed, Google Scholar, and institutional websites were employed to identify key literature on different frameworks and serve as a foundation for the research study, guiding the analysis and interpretation of data. In addition, grey literature was identified from the government agencies or DTAM, which described the characteristics, policies, processes, and activities required for the establishment and ongoing success of the RTMS for TTM. The search strategy is described in Table 1.

*Table 1 Search strategy*

<b>Research questions:</b> What are the evaluation frameworks for real-time monitoring systems?		
<b>Criteria</b>	<b>Included</b>	<b>Excluded</b>
1. Topic	<ul style="list-style-type: none"><li>• Real-time monitoring system</li><li>• Health information system</li><li>• Traditional medicines</li></ul>	<ul style="list-style-type: none"><li>• Other</li></ul>
2. Outcomes	<ul style="list-style-type: none"><li>• Framework</li></ul>	<ul style="list-style-type: none"><li>• Other</li></ul>
3. Source type	<ul style="list-style-type: none"><li>• Peer-reviewed articles</li><li>• Policy documents</li></ul>	<ul style="list-style-type: none"><li>• Articles or policy documents that do not cover either of these topics</li></ul>
4. Setting	<ul style="list-style-type: none"><li>• Any</li></ul>	<ul style="list-style-type: none"><li>• NA</li></ul>
5. Time-period	<ul style="list-style-type: none"><li>• Any</li></ul>	<ul style="list-style-type: none"><li>• NA</li></ul>

6. Language	<ul style="list-style-type: none"> <li>• English and Thai</li> <li>• Other</li> </ul>
7. Study design	<ul style="list-style-type: none"> <li>• Any</li> <li>• NA</li> </ul>
8. Data source	<ul style="list-style-type: none"> <li>• Peer-reviewed database <ul style="list-style-type: none"> <li>○ PubMed</li> <li>○ Google Scholar</li> </ul> </li> <li>• Grey literature*</li> <li>• Institutional websites*</li> </ul>

Note: \*The list of grey literature and institutional websites is shown in Appendix 1.

### Step 2: Conceptual framework development

Upon the desk-based review, the findings suggested frameworks for assessing the development and implementation of health information systems commonly described in three dimensions, technology, human, and organization. To guide the study methodology, a revised framework was developed based on the sub-dimensions of the human, organization, and technology-fit factors (HOT-fit) framework by Yusof et al.(7) and the development of an evaluation framework for health information systems (DIPSA) by Stylianides et al.(8). The developed conceptual framework is featured in Figure 2.

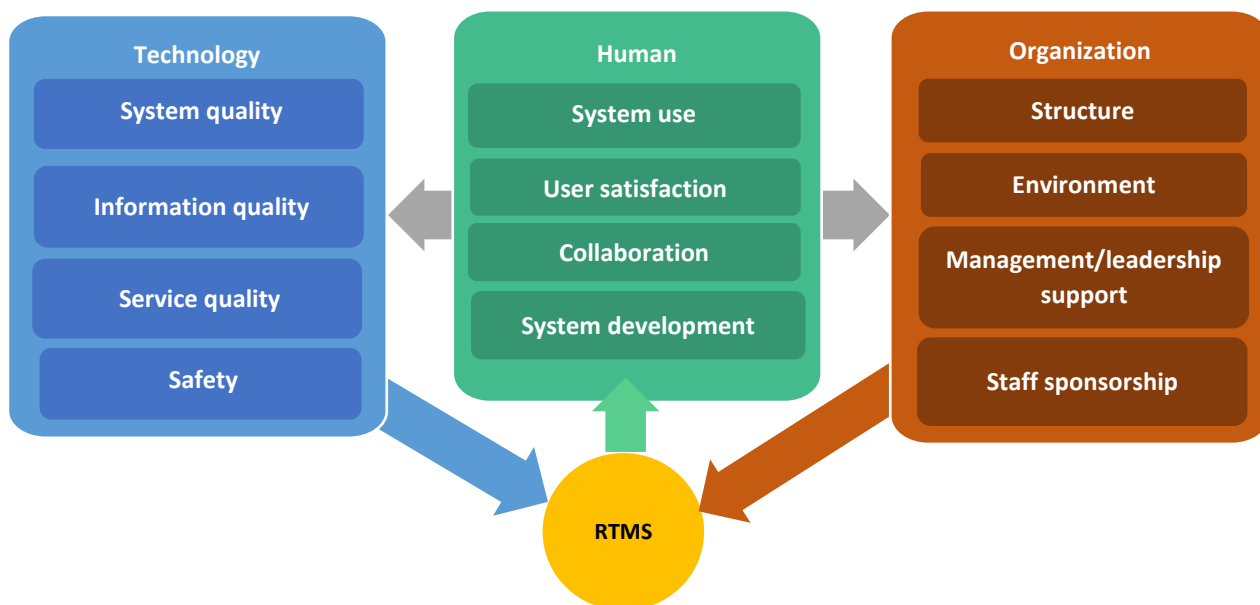


Figure 2 A conceptual framework to evaluate the real-time monitoring system of HDC TTM Service, adapted from the HOT-fit framework by Yusof et al. (8) and DIPSA framework by Stylianides et al. (9).

The conceptual framework along with a proposed study design and interview questions were then presented to relevant stakeholders involving in developing and implementing HDC TTM Service in the first stakeholder consultation meeting to obtain feedback and suggestions. Based

on the inputs received, the study plan, study participants, and interview questions were revised to ensure clarity and appropriateness for the context of HDC TTM Service.

### Step 3: Key informant interviews (KIIs)

The research team then reached out to DTAM, the government authority, and private sector professionals across various levels of background in planning, developing, and implementing of HDC TTM Service system to identify key informants for the interviews. The interview groups were classified into three groups, (1) program developers, (2) program users, and (3) data providers as shown in Table 2.

*Table 2 Details of key informant interview*

Interview groups	Details	Number*
HDC TTM Service program developers	Policymakers (e.g., Director of Academic Division and Programs)	2
	DTAM officers or staff involved in the development of the HDC TTM Service system	3
HDC TTM Service program users and implementors	Head of Thai Traditional and Alternative Medicine Division, regional office	1
	DTAM officers who maintain the HDC TTM data or DTAM those who use the information on HDC TTM Service for monitoring and evaluation.	2
	Hospital directors, doctors, or practitioners in Thai Traditional and Alternative Medicine	5
Data entry and data providers	DTAM officers or IT staff involved in data providing of the HDC TTM Service system	1
	Head of Thai Traditional and Alternative Medicine Division from different health regions	1
	Hospital directors, doctors, or practitioners in Thai Traditional and Alternative Medicine	4
	Department director/division manager/expert from the Department of Digital Information Technology Development, National Health Security Office (NHSO)	7
Total number of key informants		26

\* Number based on the list of participants received from the key informant identification meeting with DTAM officers.

This study received ethical clearance from the Institutional Review Board of Thai Traditional Medicine and Alternative Medicine (Project No: 10-2562) prior to the interviews. Participants involved in the KIIs, and stakeholder consultation meetings were fully informed about the study. They provided written and verbal consent to participate and have their data analyzed from the recorded interviews. In-depth interviews with key informants were conducted online following the interview guide provided in Appendix 2. Each interview lasted approximately 45-60 minutes, and the data were transcribed verbatim from the audio recordings. The personal information of the research participants was kept anonymous. Participants' names or organizational details

were not disclosed in the study findings nor the publication of the research report. Additionally, the funding body has no role in interpreting the study findings.

#### Step 4: Thematic analysis

The interview audio recordings were transcribed verbatim in Thai and uploaded onto NVivo software (version 14) for analysis. A team of four researchers thoroughly read each transcript multiple times to gain a comprehensive understanding of the contextual details and nuances present in the data. This iterative process involved carefully reviewing the transcripts to immerse themselves in the participants' perspectives, insights, and experiences as expressed in the interviews. Using a deductive approach, the research team coded and categorized the findings into main themes and sub-themes, ensuring the validity and consistency of the analysis through review by a group of senior researchers. Finally, the team analyzed patterns and relationships between themes and the overarching conceptual framework.

#### Step 5: Result validation and recommendations development

To synthesize the study outputs, the findings from the thematic analysis was presented to relevant stakeholders including high-level government officer, health professionals from the provincial level and representatives from the insurance scheme. The second consultation was designed to present the preliminary findings and draw lessons learned from the development and implementation of HDC TTM Service. This platform serves as a validation step for the study analysis by stakeholders from various experience in the development and the implementation phases of HDC TTM Service. The inputs received from the stakeholders were then used to develop policy recommendations for the RTMS development in Thailand and other settings.

## Results

This study involved interviews with 26 key informants, 5 (19%) were program developers, 8 (31%) were program users, and 13 (50%) were data providers. More than half of the interviewees were female (55%), while the remaining were male (45%). To assess both internal and external factors influencing the development and implementation of the RTMS, the findings were presented as strengths and weaknesses of the HDC TTM Service, as well as facilitators and challenges of the RTMS development and implementation.

#### Strengths and weaknesses of HDC TTM Service

Notably, HDC TTM Service demonstrated several strengths on an interface, online accessibility, comprehensiveness of data, real-time updates, data security measures, and satisfaction rate. Participants generally expressed a favorable perception of the RTMS, emphasizing its accessibility via a web browser with user-friendly and seamless online accessibility, allowing users to conveniently retrieve information and browse through the dashboard with easy-to-understand visualization. This flexibility enables healthcare professionals and staff to conveniently access

information from their preferred devices, such as desktop computers, laptops, or mobile phones. The HDC TTM dashboard is a comprehensive data summary of health services related to Thai traditional and alternative medicines. The information was categorized into five types of reports, including diagnoses based on ICD-10 TTM & TCM codes, herbal medicines prescribed, manual therapies provided, health promotion, and TTM services in the outpatient department (OPD) and in-patient department (IPD) visits (see Table 3). The information was displayed in bar graphs showing the provision of TTM services across 13 health regions. This allows a comparison of TTM services across health regions, provinces, districts, and sub-districts of Thailand. The data is further classified by health facility levels, outpatient and inpatient visits, and patients' health security systems.

*Table 3 Five categories and associated indicators in OPD and IPD report on the HDC-TTM Service.*

Categories	Details of reports
Diagnoses	<ul style="list-style-type: none"> <li>• Number of patients and number of visits with diagnoses based on ICD-10 TTM codes</li> <li>• Ranking of ICD-10 TTM-coded diseases and symptoms diagnosed</li> <li>• Number of patients and number of visits with diagnoses based on ICD-10 traditional Chinese medicine (TCM) codes</li> <li>• Ranking of ICD-10 TCM-coded diseases and symptoms diagnosed</li> </ul>
Herbal medicines prescribed	<ul style="list-style-type: none"> <li>• Number of visits that herbal medicines were prescribed and number of items of herbal medicines prescribed</li> <li>• Number of herbal medicine prescriptions classified by age and sex of patients</li> <li>• Top 20 herbal medicines prescribed</li> <li>• Prescribed herbal medicines classified as ED* &amp; non-ED** items</li> <li>• Value of herbal medicines prescribed, and their proportion as compared with the total value of all medicines (modern and herbal medicines) prescribed</li> </ul>
Manual Therapies provided	<ul style="list-style-type: none"> <li>• Number of TTM manual therapies classified as Nuad Thai, hot herbal compression, and herbal steam bath provided</li> <li>• Number of times post-partum TTM therapies package provided</li> </ul>
Health Promotion	<ul style="list-style-type: none"> <li>• Health promotion by Thai traditional and complementary medicine</li> </ul>
The proportion of TTM services in a health service system	<ul style="list-style-type: none"> <li>• Percentage of IPD and OPD visits receiving TTM services for all insurance schemes and the UHC scheme</li> <li>• Percentage of IPD and OPD visits receiving TTM services, excluding health promotion services, based on DTAM Key-Performance-Indicator (KPI)</li> </ul>

\*ED = Items currently on the National List of Essential Herbal Medicines

\*\*Non-ED = Items currently not on the National List of Essential Herbal Medicines

Furthermore, the program took approximately 24 hours for the information updates, enhancing the timeliness and relevance of the available data. Remarkably, the HDC TTM Service received a high satisfaction rate among program users. Most interviewees (77%) were satisfied with the HDC TTM Service, as evidenced by an average score of 4.075 out of 5. In terms of data safety, several measures are in place to ensure the safety and integrity of personal data, as the HDC TTM

database abstains from containing personal information. By design, HDC TTM Service only presented aggregated data, while the original database was stored securely under the care of MOPH's Information Center.

The study also identified several weaknesses in the HDC TTM Service that require careful attention and improvement. These weaknesses include erroneous information, limited awareness and understanding, challenges related to accessibility, the absence of a communication channel between program developers and users, and concerns regarding data transparency. Information errors were observed through drug codes highlighted in red, indicating discrepancies within the databases. Moreover, some interviewees were unaware of its existence or had never heard of the HDC TTM Service. Additionally, accessing the dashboard page posed challenges, as it may need to be displayed on the main website. Another issue was the absence of regular communication between program developers and users, which restricted users from providing valuable feedback or suggestions for improvement. When asking staff about utilizing data from HDC TTM Service, they expressed the limitation of qualitative data being presented on the dashboard. The predominance of quantitative data over qualitative information within the RTMS may constrain the depth of analytical possibilities. Lastly, there was a question about data transparency, as there was no explicit information regarding the latest updates and specific data sources in each report. These identified weaknesses highlight areas where improvements and corrective measures are needed to enhance the functionality and useability of the HDC TTM Service.

### Facilitators and challenges of the RTMS development

The development of the RTMS relies on various facilitators that contribute to its effective implementation and utilization across three dimensions: technology, human, and organization.

#### Technology

The technological aspects of the RTMS were assessed in four key areas: system quality, information quality, service quality, and safety. Most key informants agreed the HDC TTM Service with robust security measures was valuable and reliable. However, there were concerns regarding information quality, including data accuracy, completeness, appropriateness, and timeliness of reporting data. Moreover, forwarding or recording data from mobile TTM healthcare units was relatively slow, and changes made to the HDC system could impact the HDC TTM Service dashboard, resulting in incomplete or outdated information. Further, participants mentioned that it would be helpful to include more details, such as allergies, cannabis use, and TTM services for intermediate care, as it was recorded separately. Additionally, navigating and searching for specific information on HDC TTM Service could be cumbersome, requiring multiple clicks to access detailed levels of knowledge.

## Human

User-related factors that contributed to the system development of RTMS were identified, including the staff capabilities and workload of data entry personnel, linkage to performance evaluation, and administrative utilization of information. On a personal level, challenges arose from officers' proficiency in entering and using data from the system. The lack of computer literacy among officers could lead to problems with data entry and impact staff workload. There also needs to be more expertise in advanced IT among staff, which require further program development. Additionally, limited awareness of the program among staff groups, particularly in regional service units, posed additional obstacles to the system's development and utilization. The dashboard was designed to summarize TTM services provision quickly, which health personnel could use for their service performance report. However, it needed to present all relevant information about service performance indicators adequately.

## Organization

Interestingly, management and leadership support were instrumental in establishing policies, maintaining policy continuity, engaging stakeholders, conducting public relations efforts, organizing training programs, and allocating sufficient budget resources for system development. Leadership support was also deemed necessary to ensure the uptake of policies, especially when there is a constant change of leadership. This support could also be through campaigning activities such as training programs among staff. In addition, the study identified that the system environment encompassing data quality, database linkage, and collaboration among organizations would help further improve the utilization of HDC TTM service.

## Discussion

This study presents the first assessment of a real-time monitoring system for Thai traditional and alternative medicine in Southeast Asia. While numerous countries in this area have made efforts to establish online health information systems specifically designed for traditional and alternative medicine(9), a publication currently needs to be documenting the development process of a traditional medicine service monitoring system. This study captures the experience from Thailand's context, thereby offering potential lessons to similar settings elsewhere.

### Critical features of the HDC TTM system

The HDC TTM possesses several key characteristics that enhance its accessibility and user experience. One notable feature is its web-based interface allowing users to retrieve information through a web browser conveniently. Users can access the system from any location with an internet connection, eliminating the need for physical presence or specific hardware. The design incorporates easy-to-understand visualization techniques, which enhance data comprehension and interpretation. As suggested by other studies(10, 11), presenting information in a

straightforward and user-friendly interface ensures that users can quickly grasp critical insights and make informed decisions.

Another unique feature of HDC TTM service is its timeliness of the service reporting system. The entire cycle of information updates on the HDC TTM system takes approximately 24 hours, enabling effective service planning and budget allocation for TTM services. However, it is important to exercise caution when using information within this 24-hour gap, as it may impact data quality, particularly in cases of new updates or misinformation. Interestingly, this timeliness feature could be valuable during the COVID-19 pandemic. Figure 3 illustrates a notable increase in utilization of TTM services among the Thai population, particularly among individuals aged 60 and over, with a majority of female recipients (indicated in red), warranting further investigation.

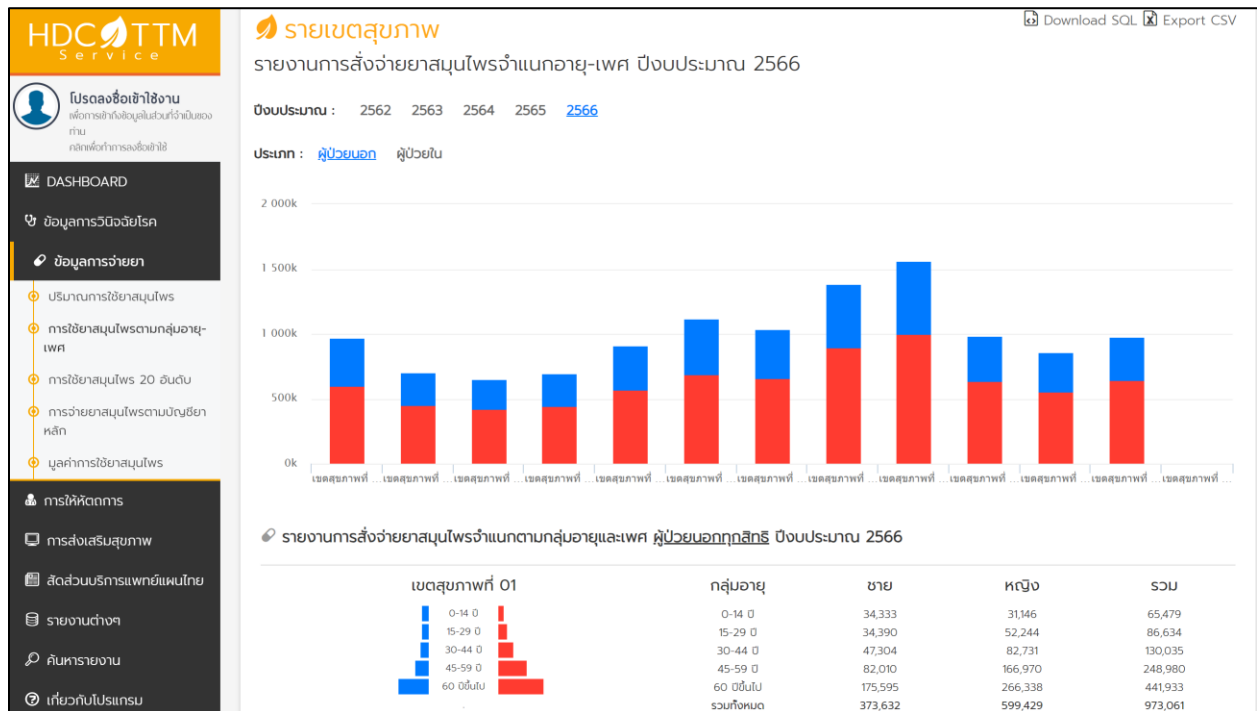


Figure 3 User interface of the HDC TTM dashboard from the report of TTM products prescribed in 2023, classified by age group and gender.

According to the HDC dashboard, the most prescribed Thai traditional medicine between 2020 and 2022 was Andrographic Paniculata (Burm.f) in a capsule formula, commonly used for respiratory symptoms such as coughs or common colds(12). This trend reflects the use of traditional medicine to treat respiratory symptoms during the COVID-19 pandemic(13). The timely reporting provided by the RTMS allows for responsive health policy planning. The data insights from the HDC TTM service can inform policymakers in formulating appropriate measures to enhance the integration of traditional medicine into the national healthcare system, fostering equitable access to care and improving overall health outcomes, both during the pandemic and in the long-term pursuit of UHC in Thailand.

## Data Infrastructure and Resource Constraints

Since the establishment of UHC with its aim to increase access to health services and reduce the incidence of catastrophic health expenditures, Thailand has been advancing its healthcare infrastructure, including the establishment of health information systems. In our experience, all health facilities involved in this study were adequately equipped with the necessary high-speed internet, computing, and telecommunication devices for the reporting system. This indicates that Thailand is ready to expand its health information system further. Inevitably, upgrades in data infrastructure and the maintenance of such a system require significant time, money, and human resources. Resource constrain in terms of specialized personnel was also observed in this study. Therefore, the government must ensure an adequate number of personnel with expertise in areas such as information, technology, and software development, to develop and enhance the RTMS effectively.

## Political support and reporting standards

The study findings emphasize the critical role of management and leadership support in establishing specific policies and driving the implementation process for the RTMS. Political support acts as a catalyst for policy change, as exemplified by the involvement of the Director General of DTAM in initiating the Thailand RTMS for TTM services. Influential leaders are essential in motivating staff to recognize the benefits of utilizing the HDC TTM system. Additionally, policymakers are essential for solid support of the digitalization of TTM at a policy level, despite the challenges of achieving interoperability among relevant health organizations(14). Such digitalization efforts aim to prevent or minimize data errors and ensure the accuracy and quality of the information presented on the HDC TTM dashboard(15).

A vital aspect highlighted for RTMS implementation is regular policy review. This study emphasizes that regulations and standards for TTM are equally important as those for modern medicine, yet regulatory bodies and decision-makers often overlook them. Reporting standards need to be established at all levels, and the practical regulatory and standardization issues in the present study mirror the barriers encountered in integrating TTM into Thailand's telemedicine efforts(16). Standardization of diagnosis and drug codes is deemed essential to establishing TTM standards across all levels of healthcare, from hospitals to MOPH departments, by developing current and emerging medical practices. Based on the reported insufficiency of the 10th edition of the International Classification of Disease (ICD-10) coding system in representing diseases and symptoms based on the TTM principles, it has been suggested to revise the current ICD-10 or apply the new ICD-11, which includes a supplementary chapter. This also aligned with a recommendation by the WHO for the development of the Thai health information system(9).

## Interlinkage of healthcare service reporting system

Thailand also needs help integrating data reports from private and non-private hospitals, contributing to incomplete or inaccurate data on the HDC TTM Service system. A WHO-SEARO

report from the meeting on indicators for monitoring the performance of traditional and complementary medicine systems highlights the presence of different reporting systems across healthcare facilities in Thailand as a contributing factor to this issue(17). This observation aligns with another WHO report (18), which emphasizes the lack of regular policy as a barrier to implementing TTM regulations. As shown in the result section, specific reports were unavailable on HDC TTM Service due to separate reporting systems for monitoring and evaluating the cannabis-containing medicine services, as well as a recording of adverse events elsewhere(19). These findings demonstrated the interconnectedness of health information systems, where specific reports may be available on different portals, posing user difficulties. This also suggests the importance of a clear directory for the HDC TTM Service dashboard on the DTAM website to allow access to information and disseminate service results to the public.

A unique finding from this study highlighted the interlinkage of health service reporting systems and incentive mechanisms. The RTMS can pick up the pitfalls from the data entry process by the TTM healthcare professionals and report back in real-time. Meanwhile, the staff must ensure the completeness and accuracy of the data entry to receive the fee-for-service incentives (20). This mechanism also helps improve the quality of the reporting service.

#### System awareness among users and user engagement

The findings from this study indicate that a significant number of healthcare staff still need to gain awareness regarding the existence of the HDC TTM Service. Despite having access to the TTM services information via the MOPH-operated HDC database, some officers needed to be aware of the HDC TTM Service dashboard that summarizes and reports the service performance in real time. The lack of awareness among health staff is common in Thailand. It has also been observed in Sri Lanka, where this has been the main challenge faced by their Traditional and Complementary Medicine (equivalent to the TT&CM report system in Sri Lanka) in integrating TTM into the healthcare delivery system(17). Training programs and publicity campaigns are essential to address these issues to raise awareness and improve the data quality within the system. Furthermore, the need for digital proficiency among personnel poses a significant barrier. Therefore, it is crucial to implement training programs at appropriate intervals, ensuring that staff is up-to-date and effective in equipping DTAM personnel with the necessary skills to enhance the performance of the RTMS.

Another key lesson from this study is the importance of comprehensive reporting and data management that incorporates users' needs during the program development process. This can be achieved through regular public hearings, surveying, and establishing effective feedback channels. While it is essential to customize the system to meet user needs, conducting surveys or establishing a communication channel is recommended to develop a plan to address the growing demand effectively.

## Limitations and further research

Notably, this study represents the first comprehensive review of a real-time monitoring system in the region. By combining evaluation approaches utilizing the HOT-fit and DIPSA frameworks, the study provides a holistic assessment of the RTMS, considering technology, human, and organizational factors. However, it should be noted that this combined assessment may only partially capture the net-benefit evaluation as outlined in the original Hot-fit framework. To gain deeper insights, further investigations should be conducted to evaluate the effectiveness of dashboards in terms of net benefit specifically.

Furthermore, it is crucial to prioritize the existing health information system of the local context when developing a real-time monitoring system. It is essential to consider the adaptability to country readiness and the environment to extrapolate the insights from this study to other settings. As set out by the integration plan of traditional medicine by WHO(6), this lesson holds significant value as it can serve as a valuable resource in the field, facilitating timely and efficient data management for healthcare services of traditional medicines. By enabling enhanced decision-making processes and contributing to improved healthcare outcomes, implementing such systems can benefit the healthcare sector.

## Conclusion

This study presents the first assessment of a real-time monitoring system for Thai traditional and alternative medicine, offering valuable insights into implementing a real-time monitoring system for Thai traditional and alternative medicine services in Thailand's healthcare system. The HDC TTM Service, an online dashboard serving as a comprehensive monitoring system, offers up-to-date information and user-friendly access. The study recommends addressing challenges such as data quality, interoperability, and policy regulations to strengthen the RTMS for TT&AM. The lessons learned from Thailand's experience can inform similar initiatives in other countries and contribute to advancing UHC goals. This study contributes to the knowledge gap in monitoring systems for traditional and alternative medicine, offering potential benefits to similar settings in Southeast Asia and beyond.

## Contributors

Conceptualization and Design: KS, BE, AC, MN, CR, SD, WI, KSC; Data Acquisition and Analysis: KS, BE, AC, MN, CR; Data Interpretation: KS, BE, AC, MN, CR, SD, WI; Writing of the Manuscript: KS, BE, AC, MN, CR; Critical Revisions: KS, BE, AC, MN, CR, SD, WI; Overall Supervision: KS, AC, WI.

## Declaration of Interests

The authors have no competing interests to declare.

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The authors have no competing interests to declare.

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## Appendix 1

List of included sources for policy documents (grey literature)

<b>No.</b>	<b>Document title</b>	<b>Sources</b>
1	Virtual regional consultation on indicators for monitoring traditional and complementary medicine system performance for the WHO South-East Asia region	WHO
2	Traditional Medicine in the WHO South-East Asia Region	WHO
3	Thai Traditional and Alternative Health Profile: Thai Traditional Medicine, Indigenous Medicine and Alternative Medicine 2014–2016	Department of Thai Traditional and Alternative Medicine, Ministry of Public Health

## Appendix 2

### Interview guide for the case study of the real-time monitoring system of Thai Traditional and Alternative Medical Services in Thailand

No.	Questions/probes
Introduction/consent	
	<p>Hello!</p> <p>Thank you for taking the time to join the key informant interview. This interview is being conducted as part of the study 'Case study of the real-time monitoring system of Thai Traditional and Alternative Medical Services in Thailand.'</p> <p>This study aims to understand the performance of the real-time monitoring system or RTMS of Thai Traditional and Alternative Medical services in Thailand. This study involves a literature review, key informant interviews, focus group discussions, and stakeholder consultation meetings. You have been included in the study because you either developed the HDC TTM Service or used the information from the HDC TTM Service. This interview covers questions to explore your general information and your experience with the RTMS system in 3 dimensions, human, organization, and technology. Reviewing the key features, facilitators, and challenges of developing and implementing the RTMS system, the lessons learned, and recommendations will be formulated from this study for creating this service in Thailand and other countries.</p> <p>This interview will take approximately 45 minutes and will be recorded for further analysis. You can refuse to answer any question or stop the discussion anytime. You will receive 500-baht remuneration as a critical informant for participating in this interview. The information regarding your data will be kept confidential and only used for the study by the researchers.</p> <p>Please confirm that you understand the statement and consent to this interview being audio recorded [PAUSE for response].</p> <p>[ No] Thank you for your time, and I apologize for the inconvenience caused.</p> <p>[Yes] Thank you, move to the next section.</p>
Section 1. General information	
1	What is your name?
2	How old are you?
3	What is your organization?
Section 2. Questions for HDC-TTM Please answer Section 2 based on your role.	
4	Are you familiar with HDC TTM Service? If so, please briefly describe your experience with the HDC TM Service. Do you identify as a program developer, implementor, or program user?
5	What, according to you, have been the main challenges faced while developing, implementing, or using HDC TTM Service?
6	What, according to you, have been the main facilitators in developing, implementing, or using HDC TTM Service?

No.	Questions/probes
7	Overall, what has been your experience developing, implementing, or using HDC TTM Service?
Section 3. Questions for the developing, implementing, or using of HDC TTM Service	
In the Human aspect, there are four dimensions: System Use (Human capacity), User satisfaction, Collaboration, and System Development (IT Staff)	
8	In your opinion, how would you describe the HDC TTM Service?
9	Does your organization use the information on HDC TTM Service? If so, how?
10	Do you find this HDC TTM Service to be satisfactory? Please explain.
11	Has the HDC-TTM Service facilitated collaboration between departments or units of your organization? Please explain.
12	How did your organization use the information from HDC TTM Service for system development? Please explain.
The Organization has four dimensions: Structure, Environment, Management support, and Staff sponsorship.	
13	What information does the HDC TTM Service allow you to access?
14	Does HDC TTM Service support the structural development within your organization? If so, how?
15	Does your organization support the use of HDC TTM Service? (e.g., providing incentives, program training, or software) If so, how?
16	Do you receive support from the management team to use the HDC TTM Service? If so, how?
17	Based on your experience, how has the information from HDC-TTM Service been used in your organization?
18	Has HDC TTM Service helped improve the performance of your work or organization? Please explain.
In the Technology aspect, there are four dimensions: System quality, Information quality, Service quality, and Safety.	
18	How would you describe the quality of information of HDC TTM Service?
19	How would you describe the safety of information of HDC TTM Service?
20	How would you describe the user-friendliness of HDC TTM Service?
21	Based on your experience, does the HDC TTM Service provide sufficient information for your needs? If not, what other information should it provide?
Conclusion	
22	What have been the significant outcomes or achievements of implementing HDC TTM Service in Thailand? Why do you think so?
23	In your opinion, how would you like to develop this HDC TTM Service in the future?

No.	Questions/probes
24	Are there any other aspects of HDC TTM Service that you would like to comment on or have suggestions for its use?
25	What would be your advice if other countries are looking to develop a similar system to HDC TTM Service?

Closing the interview: "Thank you for taking the time to answer these questions today. We appreciate your patience and cooperation during this time."